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TARGETING ON STATISTICAL CONTROL

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FOOD ENGINEERING

COVER STORY

Statistical process control allows the manufacturer to consistently produce a food product as close to target specification as possible, improving plant efficiency and saving money.

Pages 80 to 89

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FOOD ENGINEERING® (ISSN 0193-323X) October 1989, Vol. 61, No. 10. Published monthly by Chilton Company, Chilton Way, Radnor, PA 19089 (Telephone 215/964-4000). Chilton Co., one of the ABC Publishing Companies, a part of Capital Cities/ABC Inc., New York, NY. Second Class Postage Paid at Wayne, PA 19087 and additional mailing offices. Title registered in U.S. Patent Office ™Chilton Company, 1989. All rights reserved.

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Special Emphasis

DAIRY INGREDIENTS

Research in formulating foods with milk proteins must not only concentrate on finding new ingredients but on developing cost effective methods to produce them.

Pages 109 to 114

PACKAGING BUYERS SURVEY

PUSHING TECHNOLOGY TO THE LIMIT

Food products that were yesterday's dreams are on grocery shelves today because packaging put them there. Budding technologies are being pushed to their limits and suppliers are expected to meet the challenge.

PATRICIA M. DILLON
Senior Associate Editor

Refrigerated foods and shelf-stable foods are just some of yesterday's dreams that have been made possible with packaging breakthroughs. While food packagers have profited from these innovations, some problems must still be solved to reach the full potential today's packaging systems offer. Members of the *Food Engineering's* Executive Advisory Panel expressed some of these concerns in the annual Packaging Buyers Survey.

For the fourth year in a row, barrier plastics headed the priority list. Approximately 57 percent said it will be a top priority over the next two years. Although barrier packaging has made impressive contributions to shelf-life, our respondents say there is room for improvement. "Better barrier protection!" is the oft-repeated cry. Respondents want improved aroma barriers; grease barriers; thinner films; moisture/oxygen barriers; light barriers; and better thermal stability barriers.

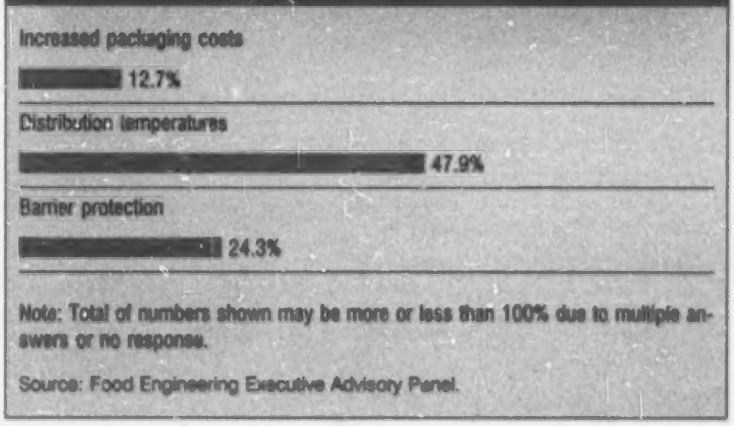
Respondents didn't hesitate to add to a wish list of what they would like to see in the future. "My fantasy packaging material would be a flexible barrier wrapping which would degrade when heated (conventional or microwave oven) to yield safe, edible, innocuous degradation products. It would be used for oven-ready, refrigerated, or frozen products," said a research specialist. Another said, "I'd love a low-cost film with superior moisture vapor transmission rate (MVTR) that runs like a bat outta hell!" And a Midwestern cereal manufacturer seeks a "cereal box that has all the barrier properties so a bag is not needed. It would need a fresh-look type of closure and seal around it. It would eliminate bagging in the bag-in-box (BIB) operation."

A California vegetable processor expressed his desire for a "flexible bag that is heat sealable that has the same barrier characteristics as aluminum foil." Another processor sought a low-cost monolayer, hot fillable, high oxygen barrier (must equal Gamma, Lamicon, etc.), clear and glossy plastic bottle; and this respondent was realistic enough to add that "this is probably not around the corner."

A summary of other requests include: more stable, less costly barrier (water and oxygen) coating for plastic containers;

Refrigerated foods

Respondents were asked what concerned them most regarding fresh refrigerated foods.



Note: Total of numbers shown may be more or less than 100% due to multiple answers or no response.

Source: Food Engineering Executive Advisory Panel.

Food packagers have recycling on their minds

"Recyclability will grow to be the biggest food issue in the next several years. We need a dual-ovenable package with the strength and rigidity of plastic yet with the recyclability or biodegradability of paperboard," said a midwesterner who participated in *Food Engineering's* Executive Advisory Panel Packaging Buyers Survey.

She was not alone, approximately 37 percent of the respondents said they are already using recyclable packaging and an additional 27 percent said they planned to use it. A Wisconsin manufacturer agreed that recycling "will be the most important criteria for future packaging choices/changes."

Other respondents wanted safe, recyclable plastic or paper with the good qualities of plastic, degradable plastic that can be run at high speeds, greater use of returnable glass and practical recycling for multilayer plastic containers.

A Chicago processor, "would like to see more use of composite materials that are biodegradable. Most plastic containers do not break up in garbage dumps (the old milk carton can be improved)."

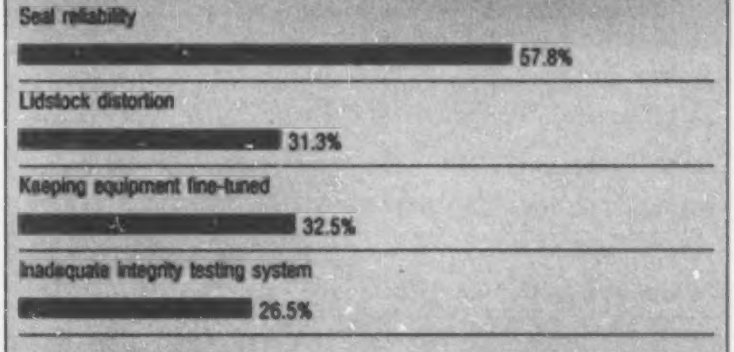
While recycling may not always be a primary consideration, it was rarely overlooked by respondents. A Kansas packaging manager wanted stockboard that resists moisture to limit the need for coatings *and* enhance recycling.

Recycling plastic packaging with its multilayers is a complex operation that requires specialized equipment. Although the Food and Drug Administration (FDA) prohibits the reuse of plastic for food packaging, it can be recycled into strong building materials. And it is becoming increasingly clear that the government is holding food processors rather than suppliers responsible for the disposal of packaging.

A pasta manufacturer requested that suppliers "be required to code their packages with the primary recyclable material. This could be etched, blow molded, printed, etc. on the package." A West Coast respondent concluded, "practical recycling for multilayer plastic containers *must* be developed for plastics to continue to grow in volume."

Flexibly-lidded products

Respondents were asked to list problems experienced in production of flexibly-lidded products.



Note: Total of numbers shown may be more or less than 100% due to multiple answers or no response.

Source: Food Engineering Executive Advisory Panel.

biodegradable barrier film; a single polymer that has the combined characteristics of polypropylene and Saran HB or EVOH protected by desiccant adhesive.

Shelf stable packaging was high on the list for a fresh food producer who said, "I would like to see high barrier, microwaveable recyclable packages and lidding material capable of holding shelf stable products."

Approximately 26.1 percent of the respondents indicated an interest in vacuum packaging. An aspect of vacuum packaging just taking its first steps in the U.S. is the French technique of sous vide (see *FE*, June '89). Sous vide offers extraordinary taste and quality never before available in prepared foods. The sous vide process involves vacuum-packing fresh raw foods in a pouch, carefully cooking it, then chilling it to 32°F and maintaining this temperature until it is reheated to serve.

CAP/MAP

Controlled/modified atmosphere packaging (CAP/MAP) (see *FE* April and Aug.'89) piqued the interest of 37.7 percent of the respondents as being a viable packaging choice. CAP consists of introducing a gas into the package and sealing it. MAP not only allows gas into the package but lets the product "breath" through its permeable barrier film.

Both the gas and the barrier film is customized to the type of product being packaged. The complexity of CAP/MAP technology apparently caused approximately 24.3 percent of the respondents to say they had problems with films and gas mixtures.

Despite the difficulties, respondents appear ready to press forward with CAP/MAP. A Midwestern product development manager said his company has been using more MAP during the past year. A New Jersey food processor wished for a "metal container that could be used for a chilled food MAP application that would utilize susceptor technology to be able to make a full meal with crispy ingredients, crisp vegetables and a cool dessert. The packaging would prevents sogginess when needed, moisture loss when needed, and heat loss when needed."

Temperature abuse

Besides envisioning the promise of a new generation of refrigerated foods offered by MAP/CAP and sous vide, respondents recognized the potential for disaster. Close to 48 percent of the respondents are concerned that refrigerated foods may not be kept at proper temperatures during distribution, spawning unacceptable microbiological contamination that would pose much more of a threat than pesticide residues ever will.

Respondents demonstrated their awareness of this issue – 58 percent said they were considering the use of time/temperature monitors. These monitors change color when temperature abuse has occurred. Approximately ten percent of the respondents already use temperature monitors on their products.

An Indiana packaging engineer voiced his desire for "a liner material that would permanently change color when exposed to atmospheric conditions."

Of the remaining 32 percent that indicated they are not using time/temperature monitors, nearly half said the present generation of indicators do not fit with their equipment. This sizable percentile presents packaging suppliers a formidable challenge

Susceptor use – why not?

Respondents said why they were not considering the use of time temperature monitors.

Materials, mergers & recyclables

Respondents were asked whether packaging decisions were seriously affected by raw material prices during the last year.

to bridge technology to equipment configurations. The remaining respondents said they were not using time/temperature sensors because of cost and because the technology was not yet reliable.

Tamper-evident packaging

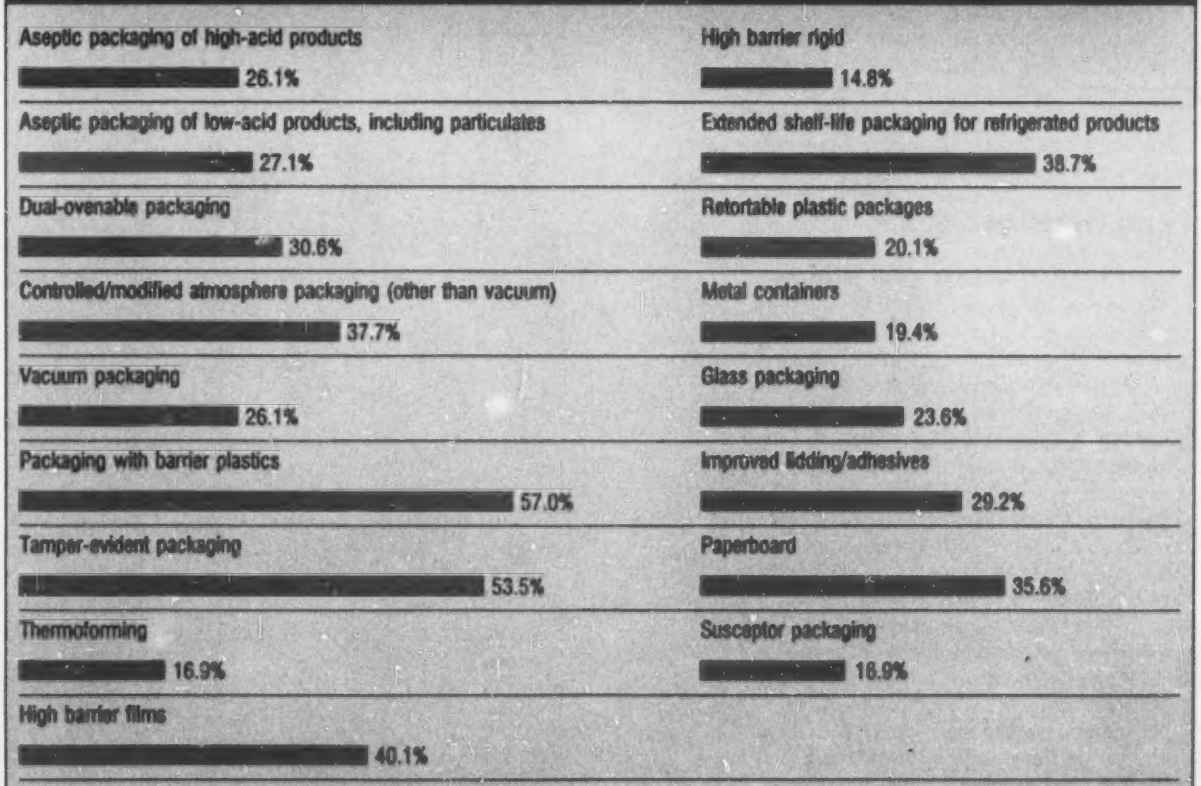
If you think tamper evidence has been put on the back burner, think again. Approximately 53.5 percent of the respondents cited tamper-evident packaging as being of major importance. Most respondents want it as an integral part of a packaging system that is both effective, inexpensive and capable of running at high speeds. A processor said he would like to see development of reclosable packages with tamper-evident seals for pasta products. He added that the low cost of the product makes it difficult to justify the cost of high-tech packaging.

A tomato processing manufacturer called for "a tamper-evident/tamper-proof closure for a widemouthed plastic cup (4, 6, 8 ounces) that is consumer-friendly, fool-proof and does not affect line speed during manufacturing." A Southeastern-based baking company acknowledged that "tamper-proof packaging for a loaf of bread is a major problem" that has yet to be solved.

Convenience is what every food processor knows consumers crave and there's no better way to spell it than M-I-C-R-O-W-A-V-E-A-B-L-E. A Midwest respondent wants to add to the convenience with "a microwaveable carton that changes color when cooking is completed." Another respondent requested "an attractive, microwaveable, disposable container for entrees that can withstand aseptic processing." A New Jersey processor would like packaging to create "crunchy, microwaveable chicken—today's packaging doesn't work."

Important packaging areas

Respondents were asked to check the areas of food packaging likely to be of most importance to their firms over the next two years.



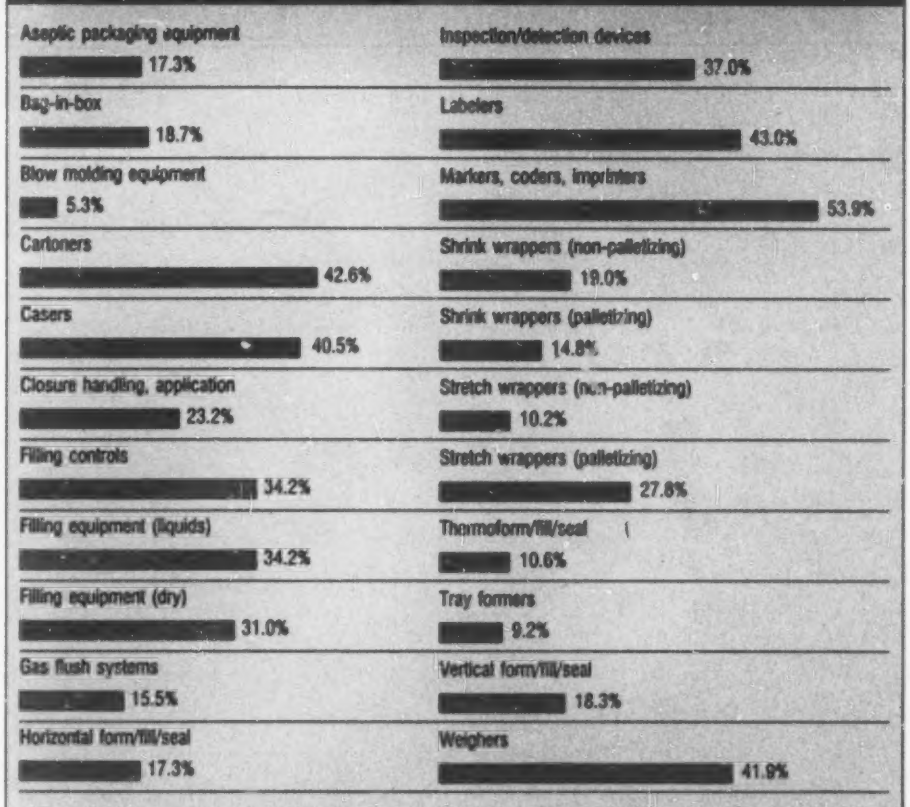
Note: Total of numbers shown may be more or less than 100% due to multiple answers or no response.

Source: Food Engineering Executive Advisory Panel.

Circle 58 on Inquiry Card→

Machinery purchases

Respondents were asked to check the types of packaging machinery their operation had purchased in the past twelve months.



Note: Total of numbers shown may be more or less than 100% due to multiple answers or no response.

Source: Food Engineering Executive Advisory Panel.

That chicken may be coming. In fact, as microwaving becomes more sophisticated, many of the requests for uniform browning may soon be fulfilled. And active needs on processors' parts usually produce active materials development on suppliers' parts. Just over half of the respondents reported using susceptor and other metal technologies to enhance microwaveable food performance.

Packaging that can be used in both a microwave and conventional oven was also a popular request. A soup producer who must be a fan of television's *Mission Impossible* put in for "inexpensive, dual-ovenable barrier packaging that would be table-presentable, automatically vent during heating, and somehow automatically trigger its own destruction some pre-set time after microwave or oven heating."

Almost 30 percent of the respondents expressed reservations regarding the present state of affairs in lidding. A frustrated processor is seeking "a plastic tub with decent lid. Right now, industry offers ones with lids that fall off or ones that need two screwdrivers and a pry bar to remove. There should be something in between—maybe a tub with a screw cap?"

A North Carolina consultant asked for "a lidding sealant film with bactericidal and spore killing properties without sacrificing normal characteristics." A major cereal manufacturer would like to see "high flexible packaging equipment with adaptive tooling to eliminate tooling changeovers while running broader range of package types, sizes." As the wish list continues, *FE's* Packaging Buyers Survey shows that food packagers will continue to expect the most from packaging technology. By pushing technology to its limits, today's dreams can become tomorrow's products.

FORMULATING FOODS WITH MILK PROTEINS

Industry acceptance of advances in milk protein research are, for the most part, market driven with economics playing a major role.

Optimum selection of milk proteins for food formulation depends on a number of factors. "You have to custom choose milk proteins taking into consideration the total food system and what you want to achieve such as nutritional enrichment, improved whipping qualities or thickening," explains Jeff Miyake, technical sales, Dairyland Products, Inc. "This includes looking at how the milk proteins will react with other ingredients in the system."

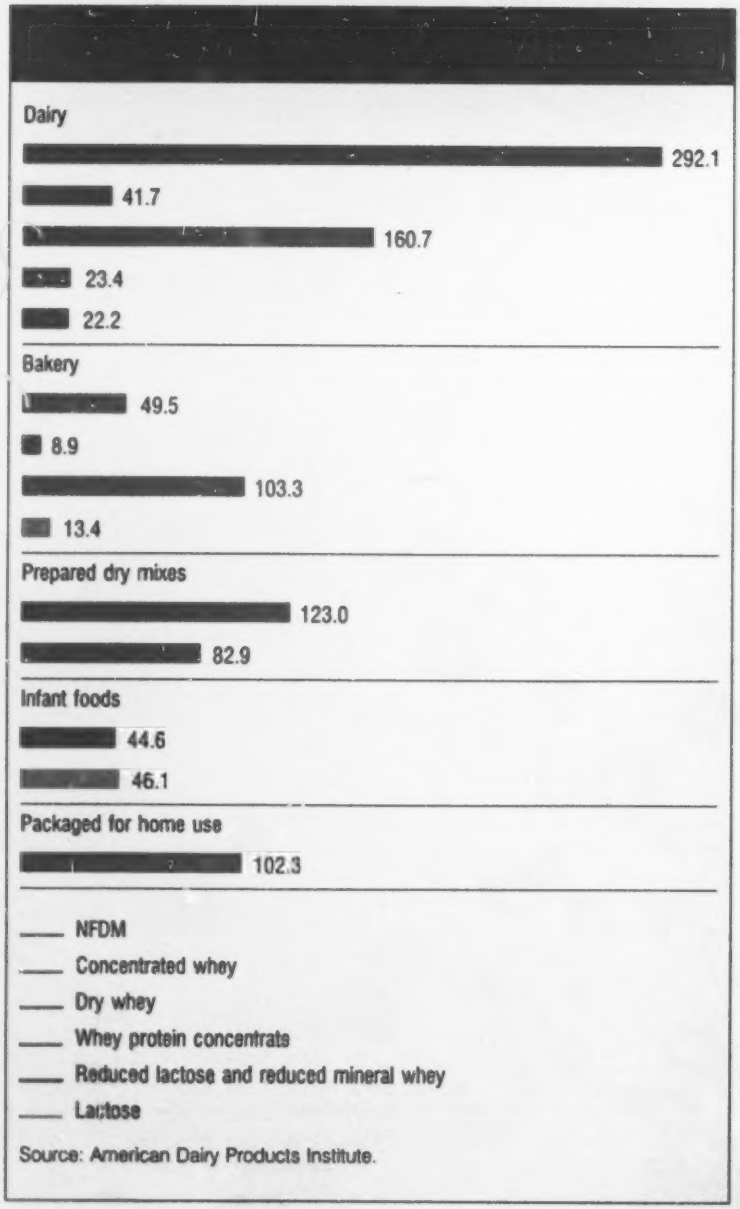
The most plentiful milk proteins available for use as food ingredients are whey proteins since they are a by-product of cheese making. These proteins constitute 20 percent of the proteins in milk. As the functionality and/or other characteristics of whey is improved, more is used in food products.

Total U.S. production of whey and modified whey products for 1988 was 1,712.4 million pounds—an increase of five percent above 1987, according to the American Dairy Products Institute. But sales of whey products for human food during 1988 in the U.S. was 783.9 million pounds—a 0.3 percent increase above 1987.

Caseins, the other milk proteins, constitute 82 percent of total milk proteins. At a pH of 4.5, caseins precipitate in the form of a curd. (Either acid or rennet can be used to precipitate caseins.) Minerals—such as sodium or calcium—are added to neutralize the caseins, which forms caseinates.

In addition to whey and caseinates, milk protein products can be made directly from skim milk. In these products, the whey and casein proteins remain bound together as they occur in milk—giving a higher viscosity when added to food systems. The proteins chains in milk protein isolates can be broken down to shorter chains by enzymes or acid.

ANN E. PRZYBYLA
Senior Editor



The resultant milk protein hydrolysates would contribute to a lower viscosity end product.

Recently, New Zealand Milk Products announced the development of a new process to separate milk proteins. The result is a new line of modified milk proteins with the brand name *AllWhip*. Their protein level ranges from 81 to 89 percent. Although the main function of AllWhip products is to provide aeration, they also provide other functions such as improved body and stability.

Various proteins such as whey, casein, soy and wheat, are often blended to obtain optimum functionality and the most advantageous cost. (When whey and casein proteins are blended, they are not bound together like milk proteins produced directly from skim milk.) Henk Hoogenkamp, director of technical services for DMV Campina Inc. and author of the book—*Milk Protein: The Complete Guide to Meat, Poultry, and Seafood*, gives the three main reasons for blending dairy and other proteins as: cost, convenience and technical (or finding the optimum ingredient in terms of functionality).

Dealing with excess ingredients among challenges faced by dairy industry

Challenges faced by the dairy industry and dairy protein research was the focus of a roundtable conducted by Food Engineering magazine on June 26, 1989 in Chicago. Four experts in this field participated (see photos). Following are some of the highlights of the discussion.

Food Engineering: Has the increased consumption of low-fat milk and the decreased consumption of whole milk resulted in an excess of milk fat? And, if so, what is being done about it?

Dr. Rambo: That is a major challenge. Historically, there's been more research done on milk than any other food ingredient. We have excess lactose which has found some use in pharmaceuticals and baby formulas. And now we have a big surplus in fat and need to find answers. They don't necessarily have to be in the food ingredient area, either.

Dr. Claypool: Our answer so far has been, let's rent another warehouse.

Dr. Hettinga: For many years we dealt with a major surplus of whey, and now we have a surplus of fat. We need to find alternate uses—some of them non-food. Some research involves polyurethane foam and making adhesives for fiberboard, or using the lactose to produce alcohol. And we are currently involved with a project to use fermentation to produce alcohol from lactose for the U.S. Department of Energy.

Dr. Claypool: The dairy industry has been its worst enemy in some cases on this milk fat problem. There's going to have to be an economic signal sent to the producers of milk to select dairy animals which produce less fat. Some animal husbandry experts predict that if economic signals were sent, we might be surprised how quickly biotechnological methods could be developed resulting in cows which produce lower fat milk.

Dr. Luksas: Dairy farmers are paid on the basis of fat production. Forty or fifty years ago, milk was produced to make butter and the skim milk was fed back to the cattle and the hogs. And the old support system still prevails. There is some talk of the support price being based on skim milk. But for now, the dairy farmer is not interested in lowering the fat.

Food Engineering: Who would make the decision to change the current system?

Dr. Claypool: The individual dairymen through their cooperatives have to participate in a policy that would support component pricing. This would reduce the value of milk fat and result in more products. And, butter would have a lower price, competing with margarine. It would also give processors the opportunity to produce products that are more attractive to the marketplace.

Dr. Hettinga: Although health is a big issue, price has been the biggest problem. Margarine is approximately $1.20 a pound and butter is $1.80 to $2.20 a pound. If that spread was narrowed, more consumers would buy butter.

Dr. Luksas: The consumer is fickle with respect to nutrition and good health. Price is still a very integral

Dairyland introduced a wheat protein isolate and sweet dairy whey blend during the past year. This blend has the advantage of having a similar protein level to milk at a lower cost. As the protein level increases so does the cost. So, in products other than nutritional ones, the lowest protein level which will achieve the desired functionality should be used.

Soy protein isolates are lower in cost than dairy proteins or wheat protein isolates but have a stronger flavor. Therefore, soy protein isolate and whey blends are a good choice for bakery products where other ingredients mask the taste of the protein.

Production quotas for dairy products in Europe

Traditionally, many European governments have subsidized milk production. These subsidies have been reduced, and production quotas for each country were established. As a result, caseinates and other dairy proteins, with the exception of whey, are in short supply. Yet, the functionality of caseinates is desired in numerous applica-

Clockwise, starting with top, left photo: Dr. David H. Hettinga, V.P. for research, technology and engineering at Land O'Lakes, Inc.; Dr. Anthony J. Lukaas, president of Dairy Research, Inc.; Dr. Larry Claypool, V.P. of research/QA for Mid-American Dairymen, Inc.; Dr. R. Scott Rombo, director of research for Dean Foods; and Ann E. Przybyla, senior editor for *Food Engineering* magazine.

part of that. By just reapportioning payment to the dairy farmer on the basis of total solids, the sugar value, the protein value and the fat value, part of the problem would be solved.

Food Engineering: What research is being conducted in the dairy field with respect to improved functionality of dairy proteins?

Dr. Claypool: We try to react to the marketplace on a very specific, individual basis. In other words, we attempt to take a given technology or a given dairy ingredient and customize it into whatever the needs are of the food company we're working with. Dairy ingredients can be integrated into virtually every product but you have react to the marketplace.

Dr. Hettinga: An area where you'll see a new market being developed in the future is fractionated fats. Work has been done in this area in Europe but little has been done in this country.

Fractionated fats are used in croissants and cookies. Or, various soft fractions may be used in spreadable, squeezable butter oils.

Dr. Lukaas: In fractionating fats, basically as the temperature is lowered, products are centrifuged out. For example, as butter is cooled, a cloudiness caused by crystal formation develops. These crystals are then centrifuged out, and as the temperature continues to be lowered, even more fractions can be centrifuged out. The point is, you could fractionate butter producing quality end products for various applications. The technology is available, but it's uneconomical.

Dr. Hettinga: That is one area where Europe has an advantage. They have developed a number of products, and are able to sell enormous amounts of fat that way.

Dr. Lukaas: A technology that we have been involved in is freeze concentration. It can result in the production of specific isolates of whey protein, not only in terms of purity as a whole but also fractionating the whey proteins themselves.

Food Engineering: How does freeze concentration work?

Dr. Lukaas: The dairy product is frozen and ice crystals are formed. As this happens components other than the water start precipitating out. And, many of the proteins have their own precipitation point under refrigerated conditions and under specific water activity levels.

An advantage of freeze concentration is that current methods for separation of milk proteins cause some form of denaturation. Even with ultrafiltration surface denaturization occurs. With freeze concentration there is no protein denaturization.

Dr. Claypool: The development of freeze concentration is the result of a joint venture. It is a new approach to funding high-risk dairy research—the dairy industry funds research through the National Dairy Council resulting in a corporation with limited and general partners.

Dr. Hettinga: The final determination of whether the dairy industry adopts a new process will be if the process is economical and the most efficient compared to other methods available. It also depends on the market. If you need a highly undenatured whey protein, freeze concentration may have a very viable opportunity in the future. But it will have to compete with what's available.

tions.

This shortage has resulted in companies looking for ways to reduce the level of casein proteins while maintaining the functionality that they contribute. The combination of European protein technology with U.S. spray drying capability has achieved this by spray drying whey protein and caseinates together, explains Finbarr O'Driscoll, president of Beatreme/Kerry Foods, Inc.

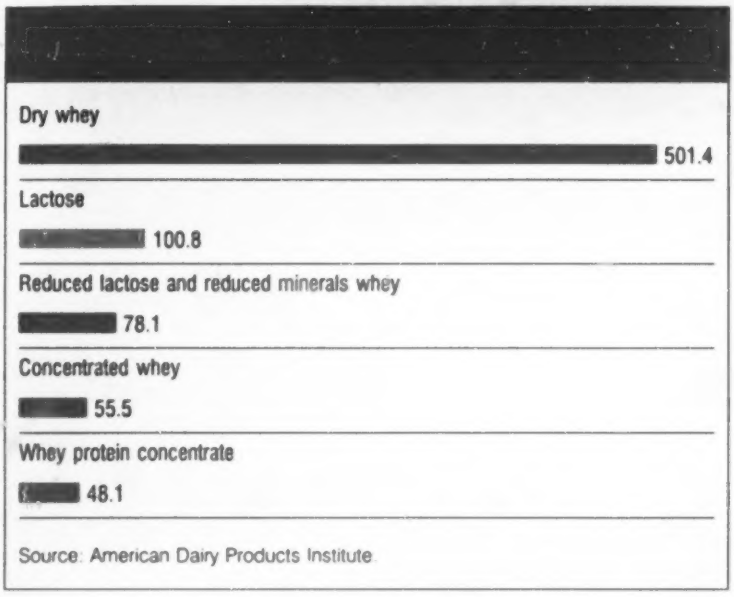
Currently, the percentage of protein required in whey isolates, concentrates and powder is not regulated in the U.S. A general rule of thumb, according to Hoogenkamp, is: 90 percent or higher for isolates, 60 to 70 percent concentrates, and 30 to 35 percent for powder.

Recent development in dairy protein research

A major breakthrough in dairy protein research was announced by The NutraSweet Company last year. Simplesse—a fat substitute—is made from milk protein (whey) and/or egg whites, vegetable gum, lecithin, sugar, acid and water. This premix is then

Product	Protein level	Characteristics	Recommended applications
Whey products:			
Sweet acid whey	Approx. 12% protein; 75% lactose	Offers cost advantage; soluble at pH 4.6	Bakery products, carrier for flavors, frozen desserts, snack foods
Reduced lactose whey	Approx. 22% protein; 50% lactose	Less of a problem with browning of lactose	Cold pack cheese, nutritional feeding products
Reduced mineral whey	Approx. 16% protein	Lower mineral content	Infant formulas
Whey protein concentrate	35-80% protein	Heat sensitive; high solubility; bland taste; increased protein level over regular whey	Egg white replacer, nutritional beverages and/or supplements, acidic beverages, processed cheese, processed meats
Whey protein isolate	90+% protein	Good nutritional properties; poor solubility	Frozen and aerated desserts, nutritional beverages and foods, diet foods
Lactalbumin	One of the whey proteins	Good nutritional properties; insoluble	Infant formulas; diet foods
Caseinates:			
Sodium caseinate	90+% protein	Extremely heat stable; more soluble than Ca caseinate; good emulsifier	Whipped toppings, meat products such as sausage
Calcium caseinate	90+% protein	Extremely heat stable; better flavor than Na caseinste	Milk-based product; low-fat meat products
Blends:			
Caseinate/whey	Approx. 33% protein	Similar protein level to NFDM; proteins not bound chemically as in milk protein isolates, therefore, better emulsifier	Meat products; milk replacer
Whey/wheat protein isolate	Approx. 33-36% protein	Has similar protein level to NFDR	Bakery products
Whey/soy protein isolate	Approx. 33-36% protein	Cost advantage	Bakery products
Other:			
Milk protein isolates	Approx. 90+% protein	Proteins bound together, therefore, gives higher viscosity	Nutritional beverages
Milk protein hydrolysates	Approx. 90+% protein, but proteins broken down to shorter chains by enzymes or acid	Lower viscosity, improved whipping qualities	Meat products—especially pump solution for hams, nutritional beverages, aerated desserts
Modified milk protein	81-89% protein	Specifically developed as a whipping aid	Frozen yogurt, whipped fruit beverages, aerated confections, whipped toppings
NFDM	36% protein	Good flavor	Yogurt, cottage cheese, ice cream, nutritional products

Source: Food Engineering Magazine.



deaerated, preheated, and spheroidal microparticles from 0.1 to 3 microns are formed using intense agitation and heat. A GRAS petition, accepted for filing by the FDA on November 23, 1988, cites studies showing that the nutritional value of the protein is not altered in the manufacturing process (see *Food Engineering*, March, 1989, p. 71).

Other advances in milk protein research can be seen by reviewing the patents filed in this area during the past few years. These fall into two main categories. The first group is for processes which increase whey's functionality. While the second group of patents describes the production of food products which incorporate dairy proteins. Specifics of some of the patents are described below.

• On January 19, 1988, a patent for *Preparation of Gelled Food Products* was awarded to Nestec S.A., Vevey, Switzerland. A process to prepare thermally gelled emulsions without having to add thickeners or calcium is described. An aqueous medium containing gellable whey proteins is homogenized with a lipidic medium, after which the emulsion is heat treated.

This process may be used for preparing egg custards, omelettes, pancakes, quiches, sausages, jellies, desserts and spreadable creams. (The gellable whey is preferably in the form of concentrates obtained by ultrafiltration of sweet whey, optionally followed by diafiltration [ultrafiltration with dilution], containing from 50 to 90 percent and preferably from 79 to 90 percent by weight of proteins, based on dry matter.)

• On June 13, 1989, a patent for a *Method for producing a pre-proofed, frozen and unbaked dough having an improved shelf life* was awarded to General Foods Corp. (now Kraft General Foods). This patent describes how the addition of a mixture of skim milk and whey proteins is added to dough at a 2.5 to 5 percent level, by weight, for products with less than 30 percent, by weight, of butter, and at a 2.2 percent level, by weight, for doughs with more than 30 percent, by weight, of butter (mainly croissants).

While whey has been used previously to increase shelf life of doughs, the patent's authors say that it has resulted in a negative effect on taste which is not the case with this product. The whey protein component used in this frozen dough is obtained by coagulating skim milk by an organic culture, preferably rennet.

• On November 15, 1988, a patent for a *Low Fat Coffee Whitener and Method for Making Low Fat Coffee Whitener* was awarded to The Pro-Mark Companies, Tulsa, OK. The whitener is made from low fat milk having a butter fat content not exceeding 1.0 percent by weight, preferably less than 0.4 percent, nonfat dry milk solids (NFDM), an emulsifier (preferably a monodiglyceride) and a whitening agent.

The NFDM solids are preferably specially heat modified and are derived from a process in which condensed skim milk is subjected to non-coagulative direct steam heating prior to spray drying. The resultant product is claimed to resemble conventional high butterfat content coffee creamers in appearance, taste and mouth feel but has negligible levels of saturated fat and cholesterol.

• On May 31, 1988, a patent for a *Process for the Manufacture of a Frothy Drink Composition* was awarded to Nestec S.S., Vevey, Switzerland. The process is for the preparation of a powdered mix for a frothy beverage which is prepared from an aqueous solution and suspension of fats, proteins, lactose and other carbohydrates. The suspension is preheated, heated, concentrated, gasified, pasteurized and then spray dried.

Examples of a beverages made by this process would be soluble coffee which is mixed with hot water or hot liquid coffee to obtain a kind of "cappuccino," and a cocoa-flavored beverage. The manufacture of these beverages necessitates ensuring thorough mixing with a liquid.

As research results in new and improved foods incorporating dairy proteins, their appearance on the market will be determined by whether consumers decide that there is a favorable price/value relationship.